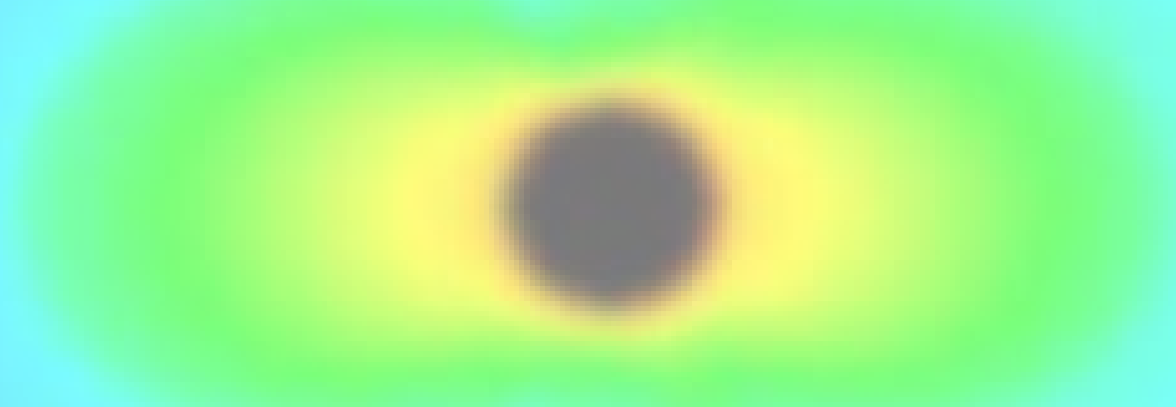


The Plasmasphere



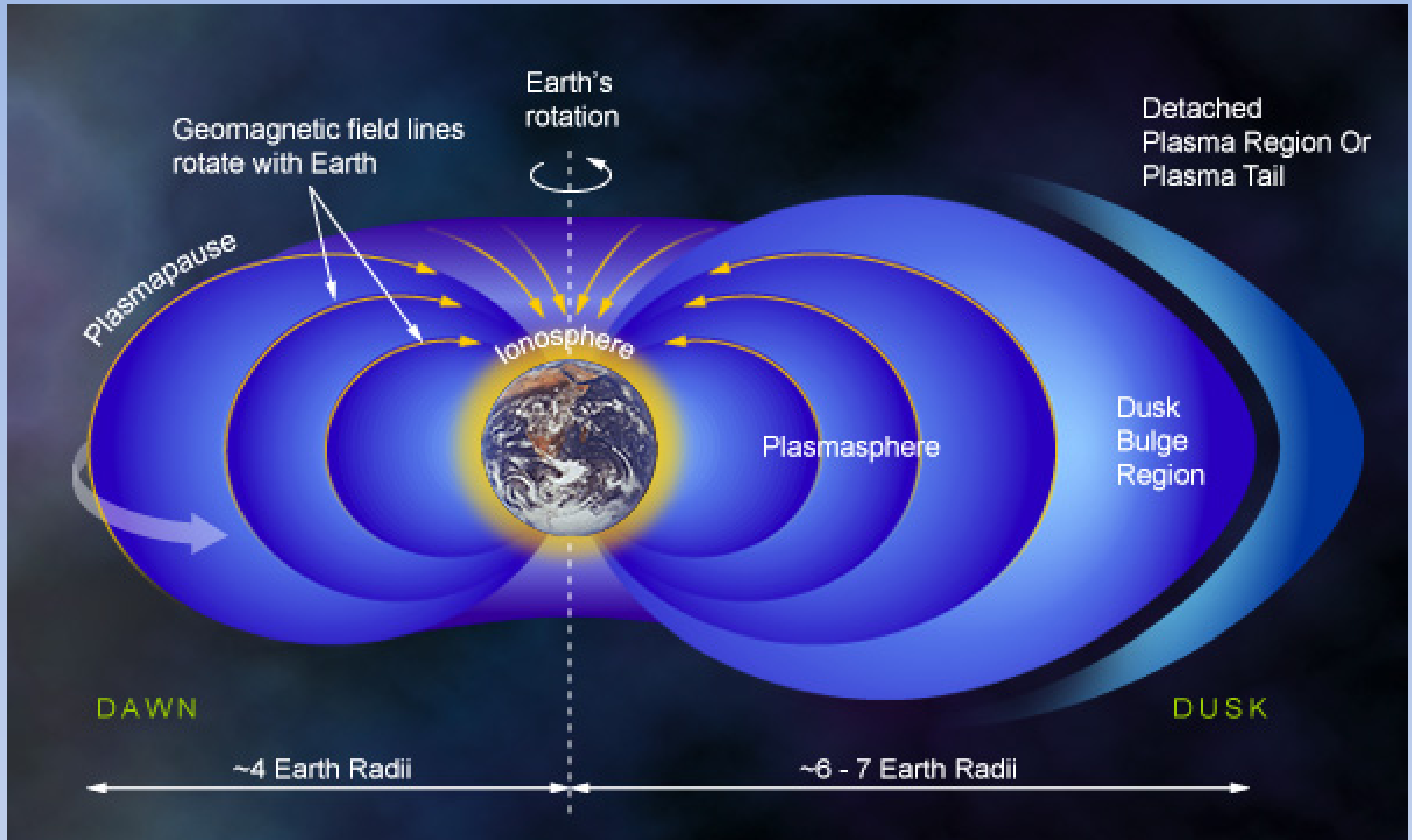
D. L. Gallagher, NASA/MSFC
dennis.gallagher@nasa.gov

Outline

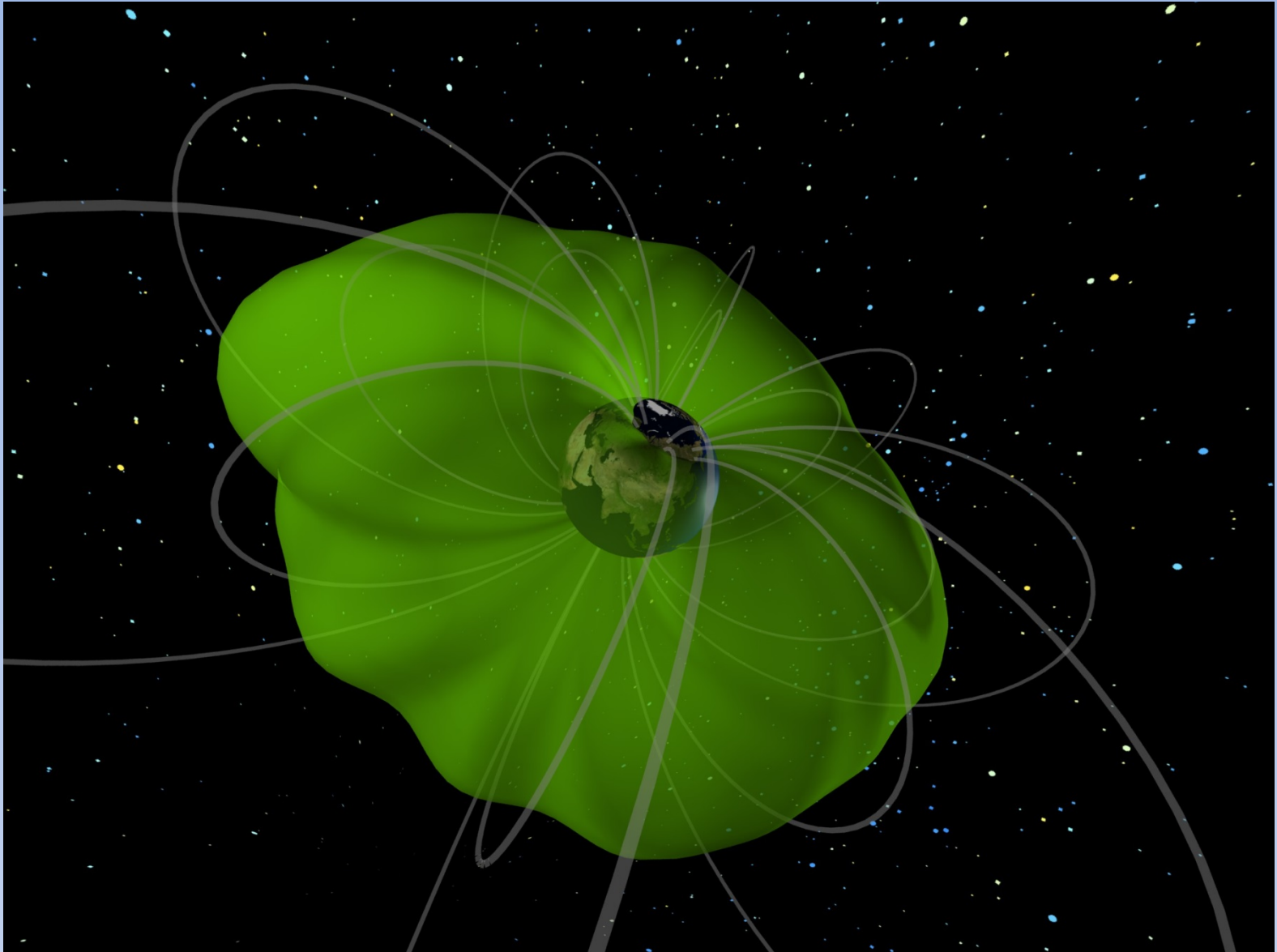
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- The quest to understand the new data.

Exosphere-Plasmasphere

(ionized gas)



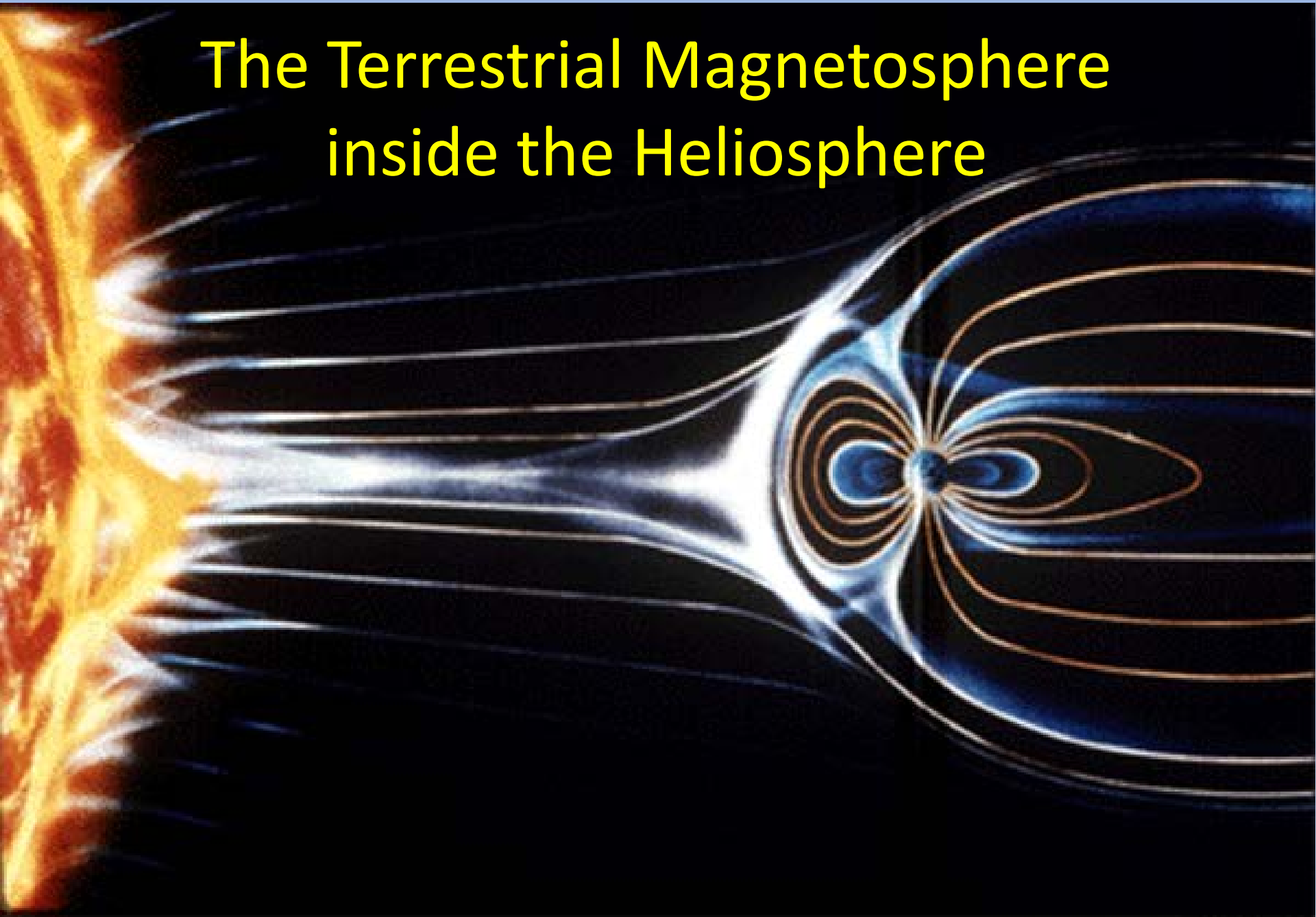
Plasmaspheric Shape Follows B-Field



Outline

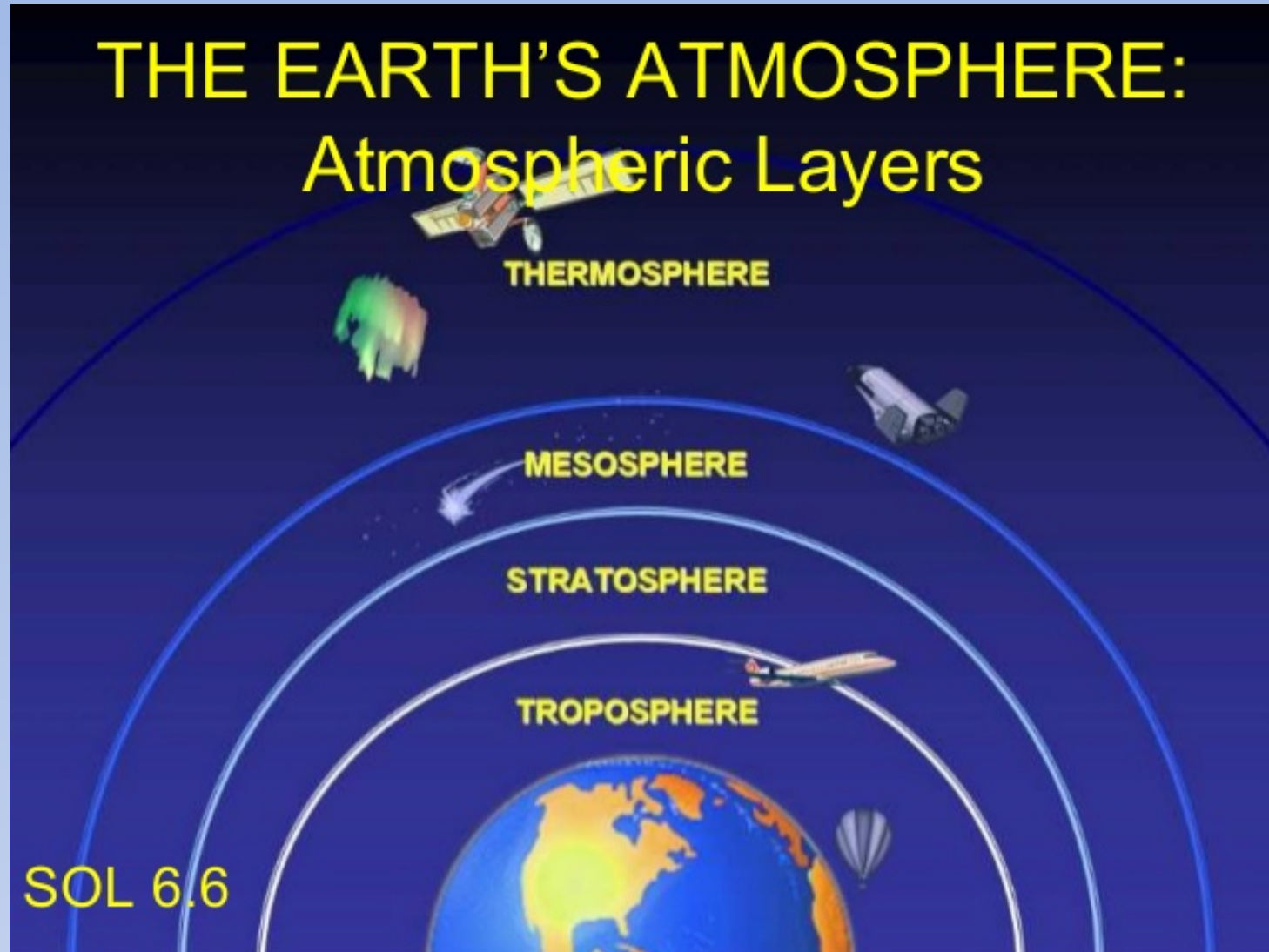
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The Terrestrial Magnetosphere inside the Heliosphere

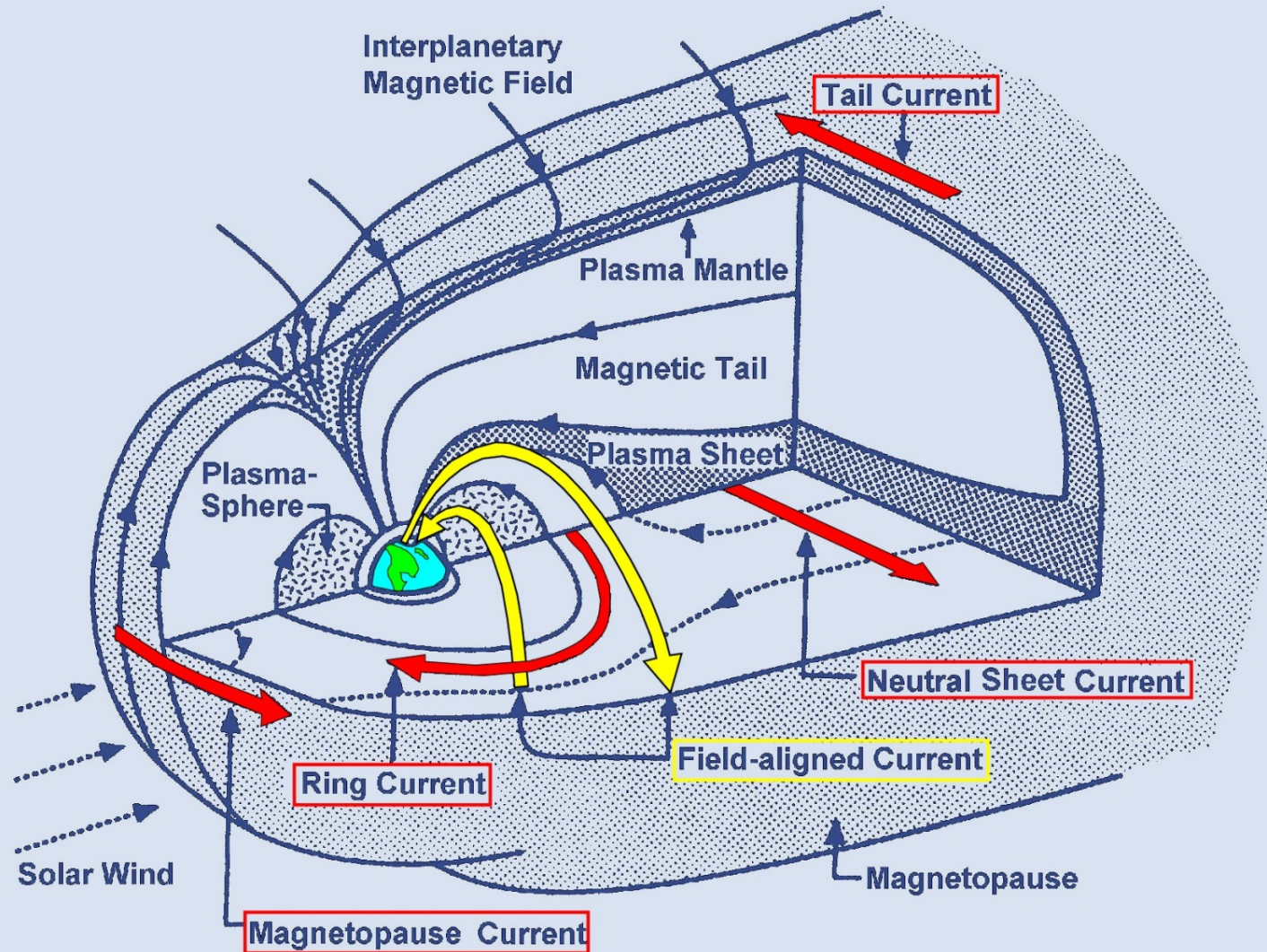


Earth's Atmosphere

(Neutral Gas)



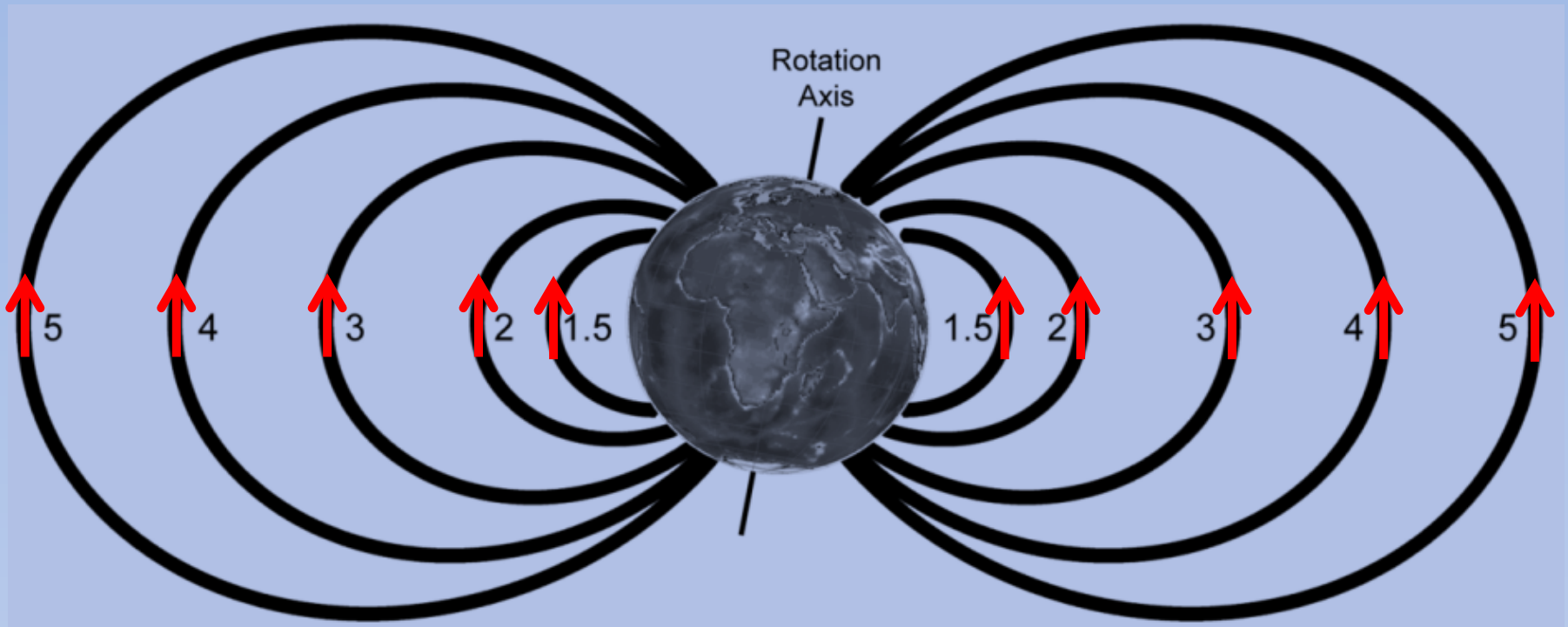
The Magnetosphere



Outline

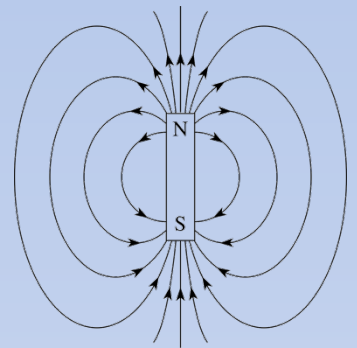
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McIlwain L-Shell Parameter



https://en.wikipedia.org/wiki/L-shell#/media/File:L_shell_global_dipole.png

http://www.met.reading.ac.uk/pplato2/h-flap/phys4_2.html



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Matters of the Plasmasphere

- Why should anyone care about the plasmasphere?
 - Cold, dense plasma influences wave modes, wave propagation, wave-particle instability, particle-scattering effects, spacecraft charging
- There may be ionospheric outflow at all latitudes and local times.

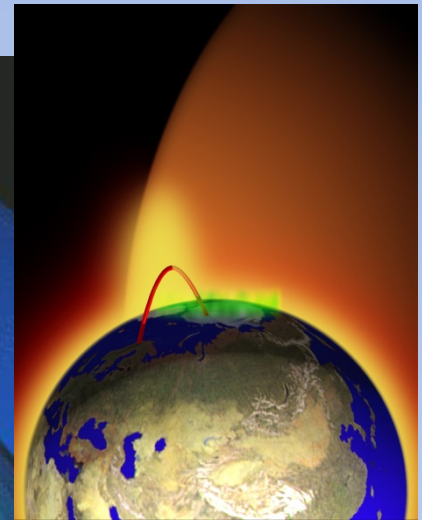
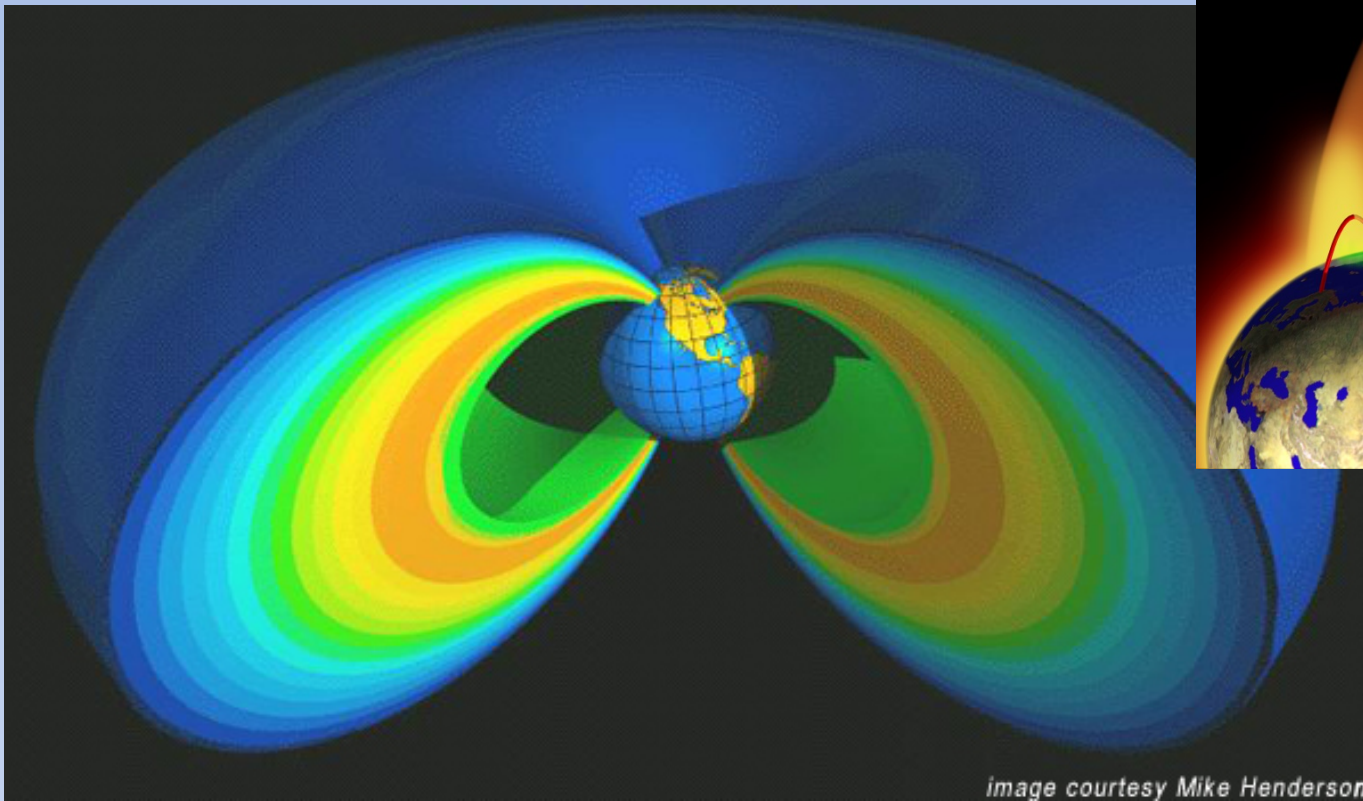
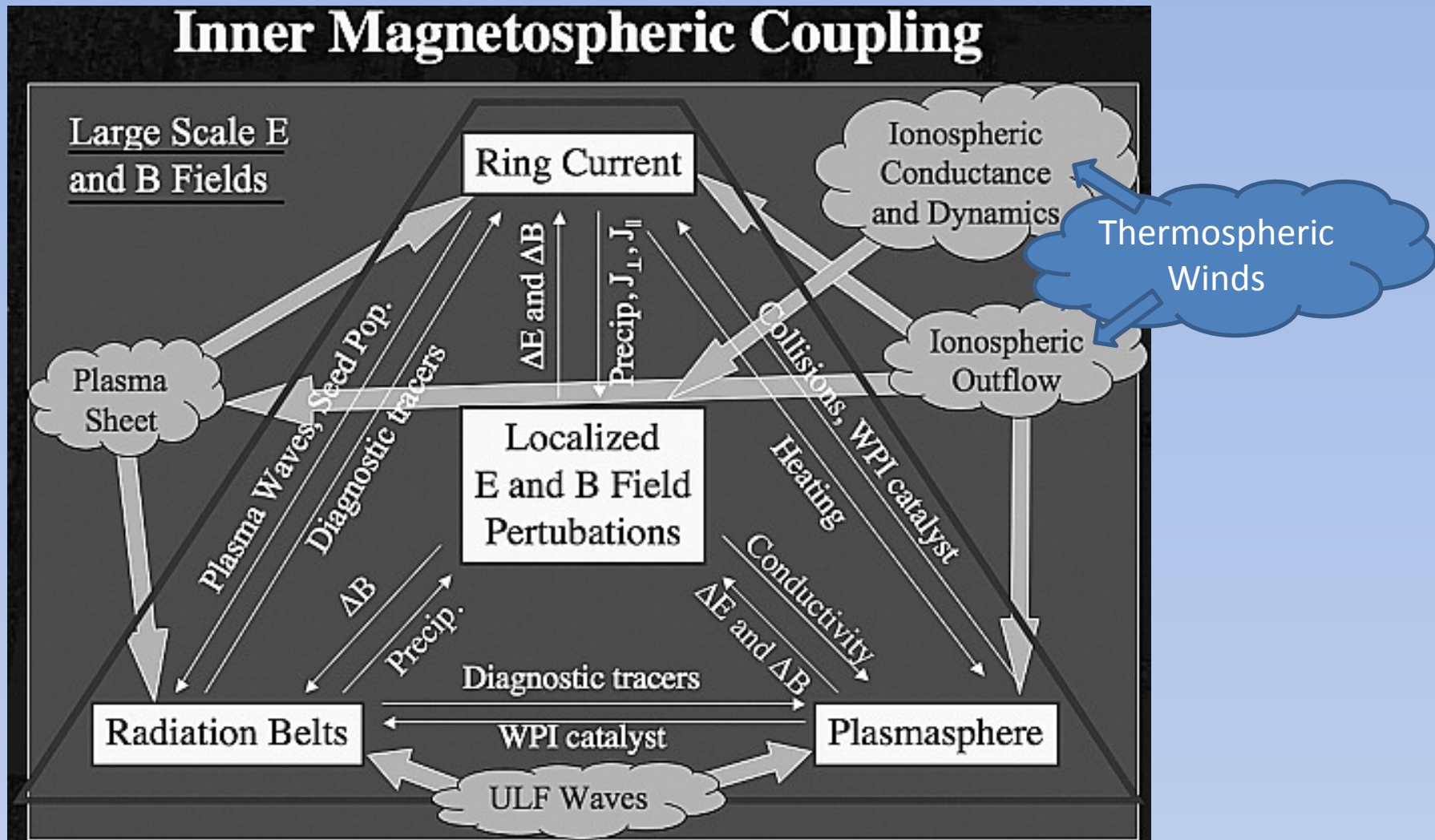


image courtesy Mike Henderson

Outline

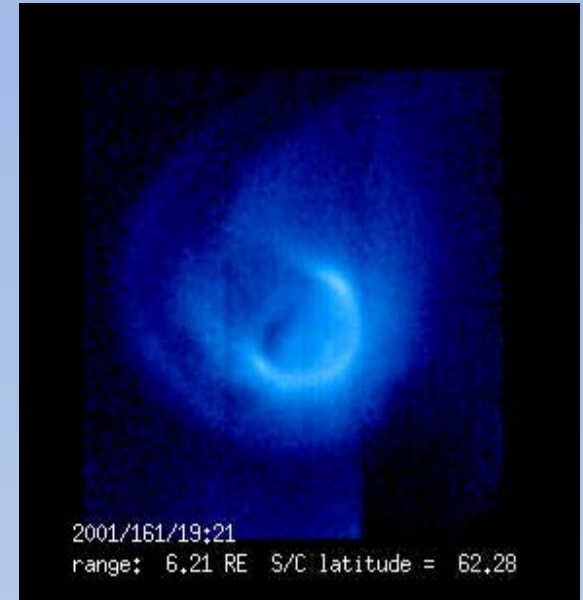
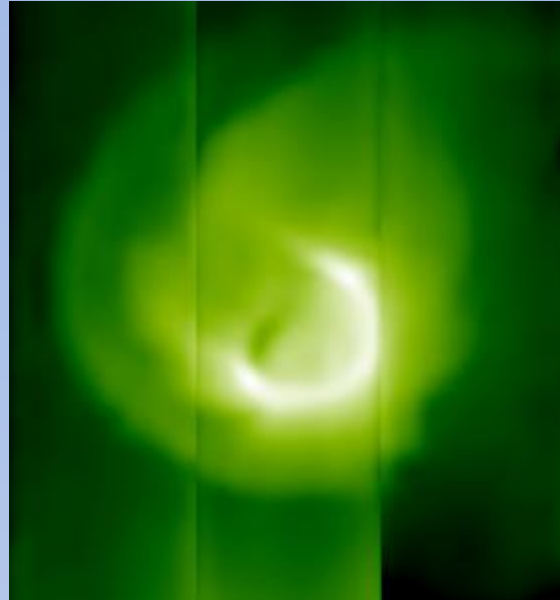
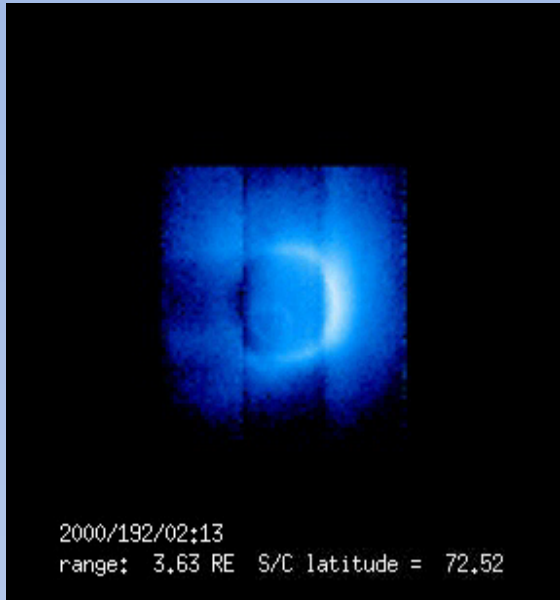
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Introduction to special section on “Results of the National Science Foundation Geospace Environment Modeling Inner Magnetosphere/Storms Assessment Challenge”

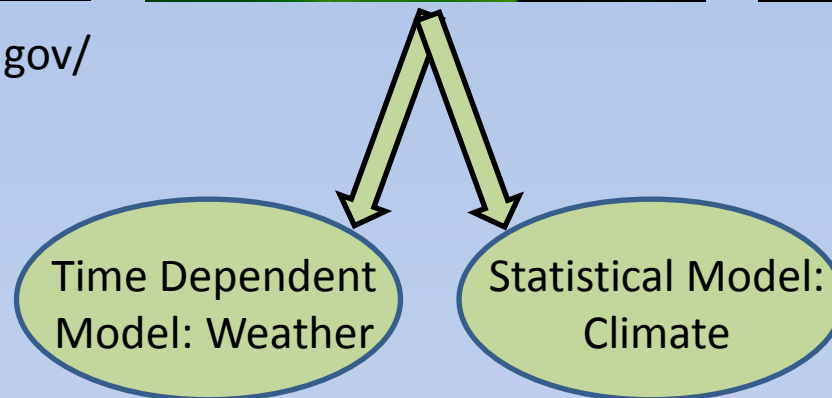


The Dynamic Plasmasphere

Imager for Magnetopause-to-Aurora Global Exploration – Extreme Ultraviolet Imager



<http://image.gsfc.nasa.gov/>



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GCPM 2000 – a N_e Model

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 105, NO. A8, PAGES 18,819–18,833, AUGUST 1, 2000

Global core plasma model

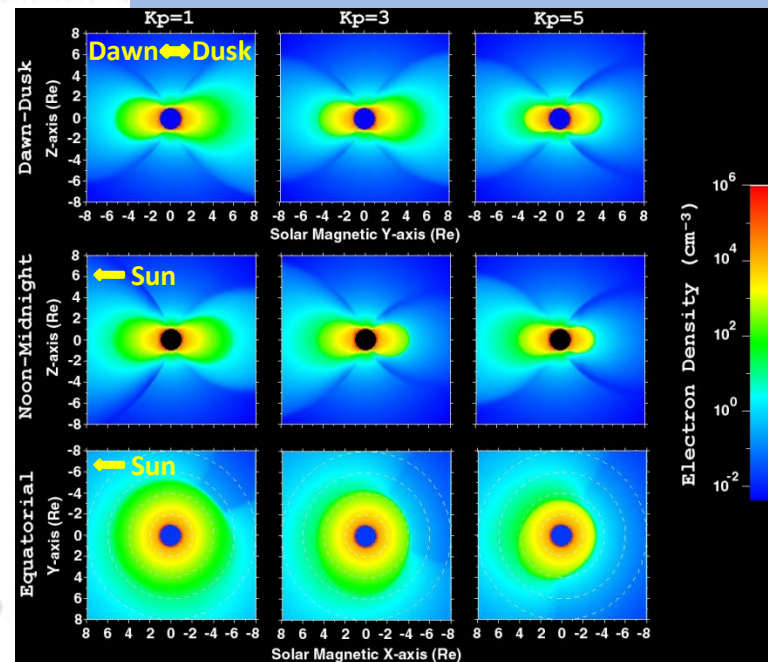
D. L. Gallagher and P. D. Craven

Space Science Department, NASA Marshall Space Flight Center, Huntsville, Alabama

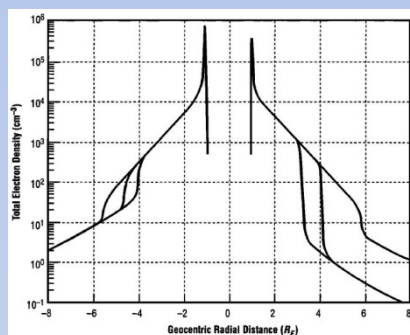
R. H. Comfort

Center for Space Plasma and Aerodynamic Research, University of Alabama in Huntsville

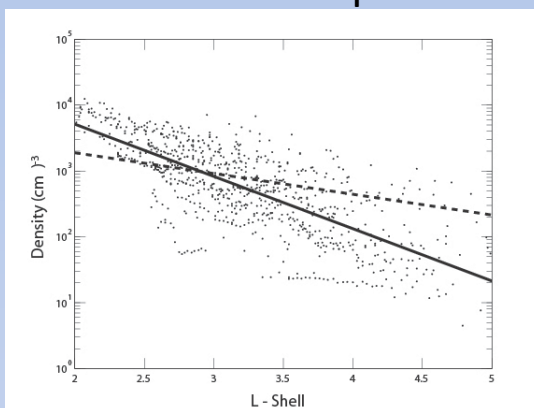
Abstract. The global core plasma model (GCPM) provides empirically derived core plasma density as a function of geomagnetic and solar conditions throughout the inner magnetosphere. It is continuous in value and gradient and is composed of separate models for the ionosphere, plasmasphere, plasmapause, trough, and polar cap. The relative composition of plasmaspheric H^+ , He^+ , and O^+ is included in the GCPM. A blunt plasmaspheric bulge and rotation of the bulge with changing geomagnetic conditions is included. The GCPM is an amalgam of density models intended to serve as a framework for continued improvement as new measurements become available and are used to characterize core plasma density, composition, and temperature.



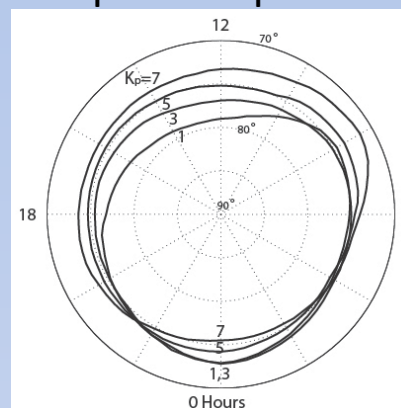
Overall PS Profile



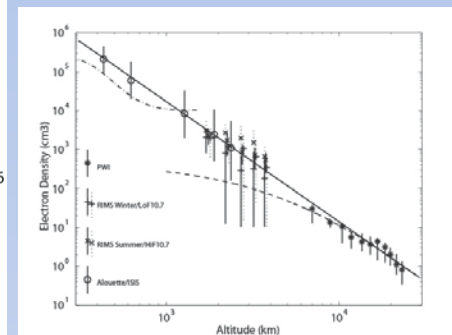
Inner Plasmasphere



Eq Plasmapause

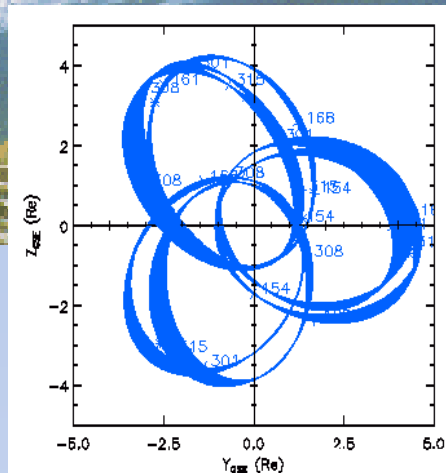
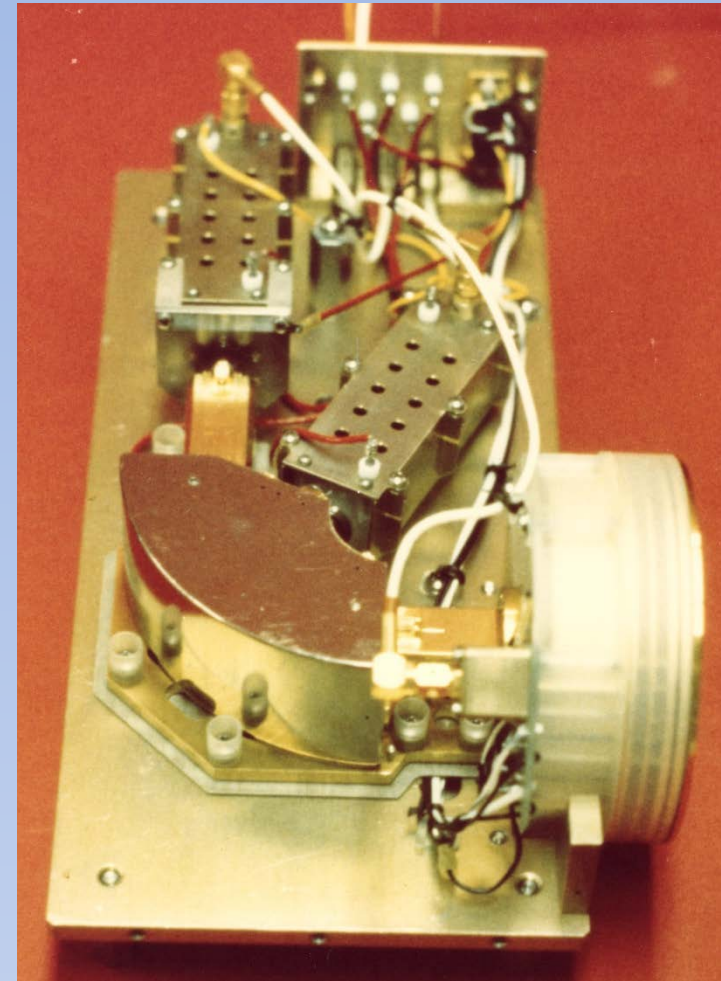


Polar Cap



Measuring the Plasmasphere with the Dynamics Explorer 1 Retarding Ion Mass Spectrometer

Densities &
Temperatures:
 H^+ ,
 He^+ , He^{++} ,
 O^+ , O^{++}



Orbit samples
over time
period of data

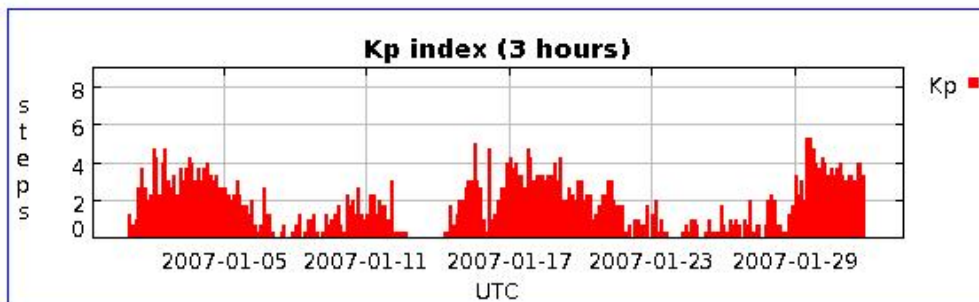
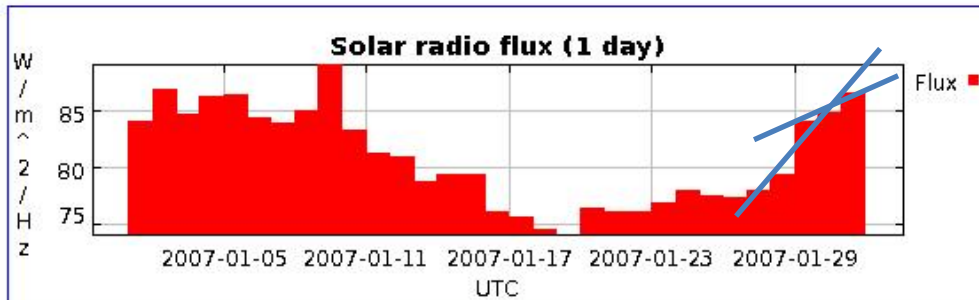
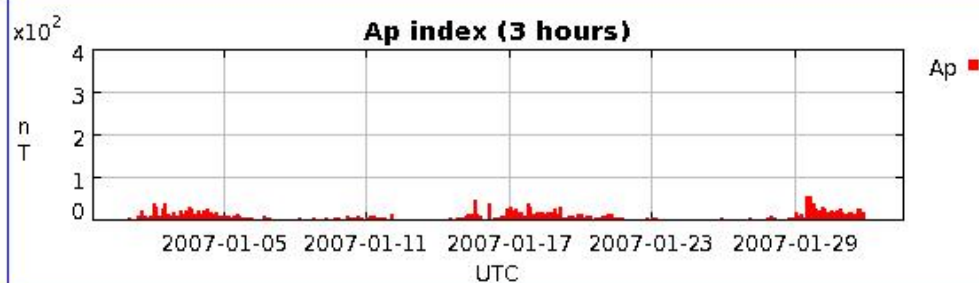
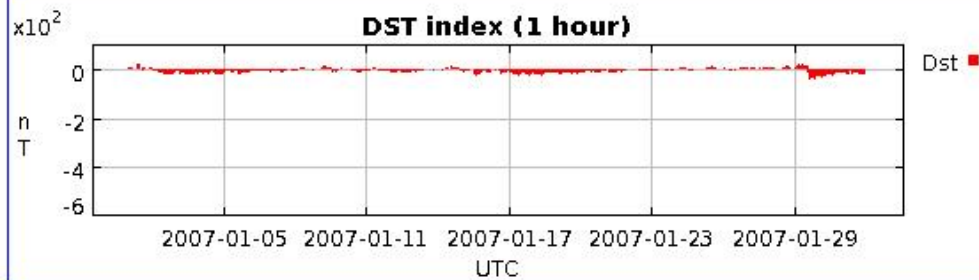
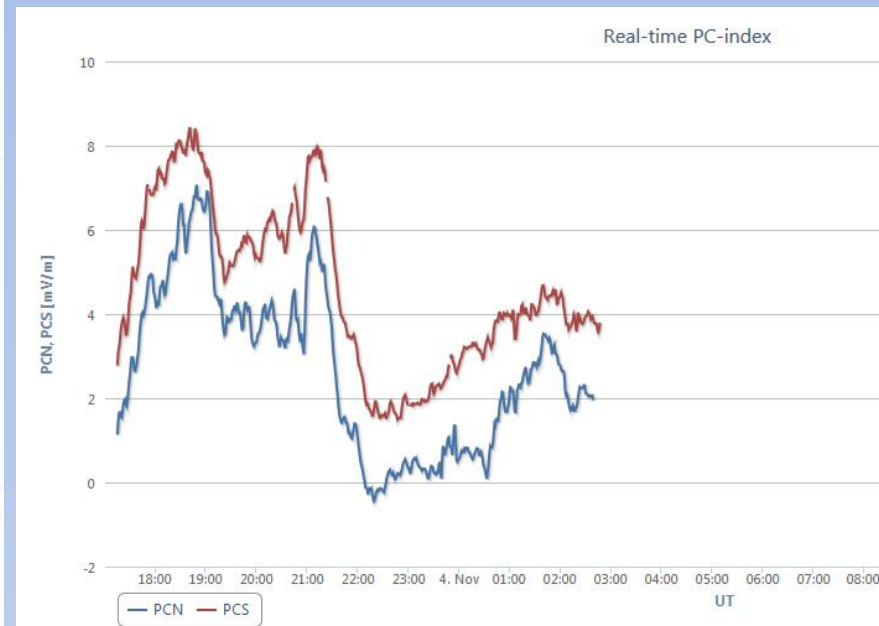
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How Can Conditions be Quantified?

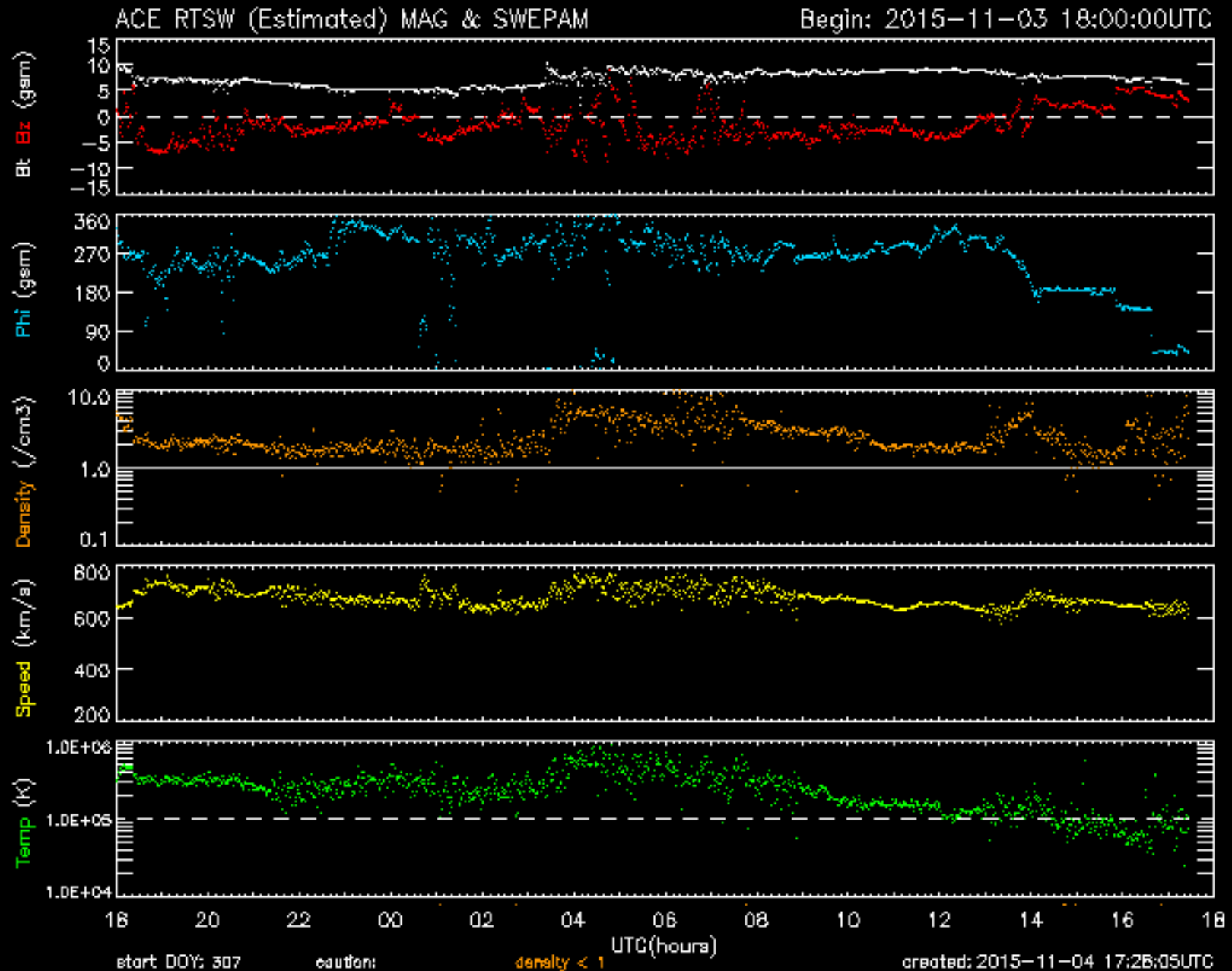
Values and trends,
both short term
and long term

Polar Cap Index



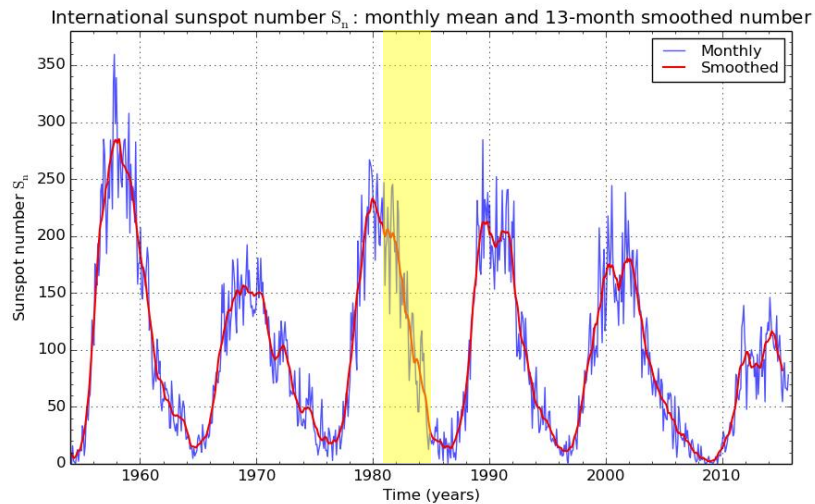
How Can Conditions be Quantified?

Solar Wind Density, speed, and IMF



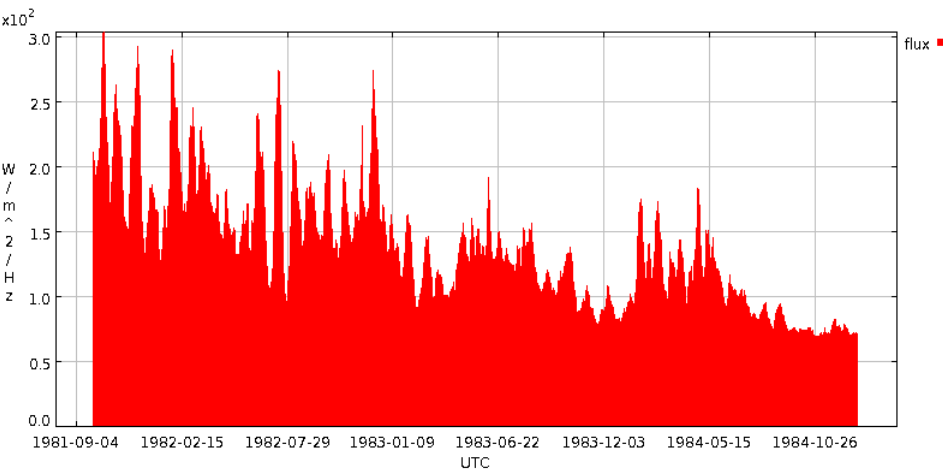
Space Weather Conditions for RIMS

Sunspot Number

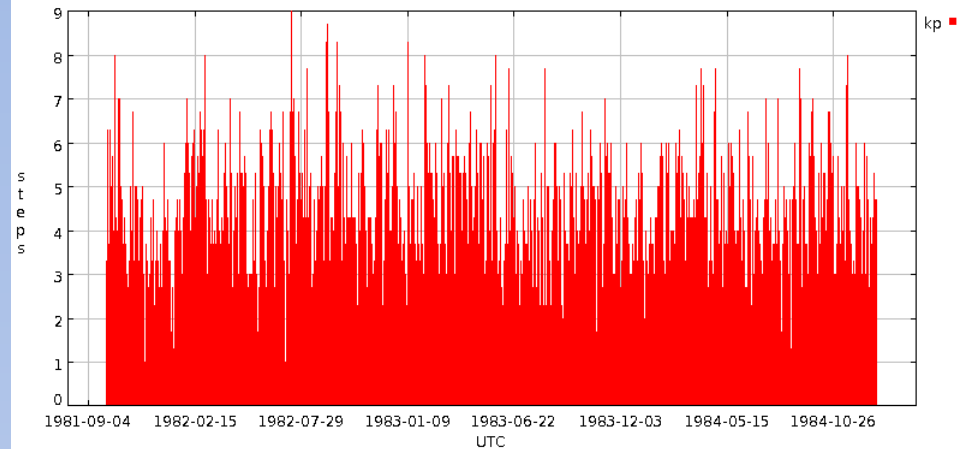


SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium 2015 October 2

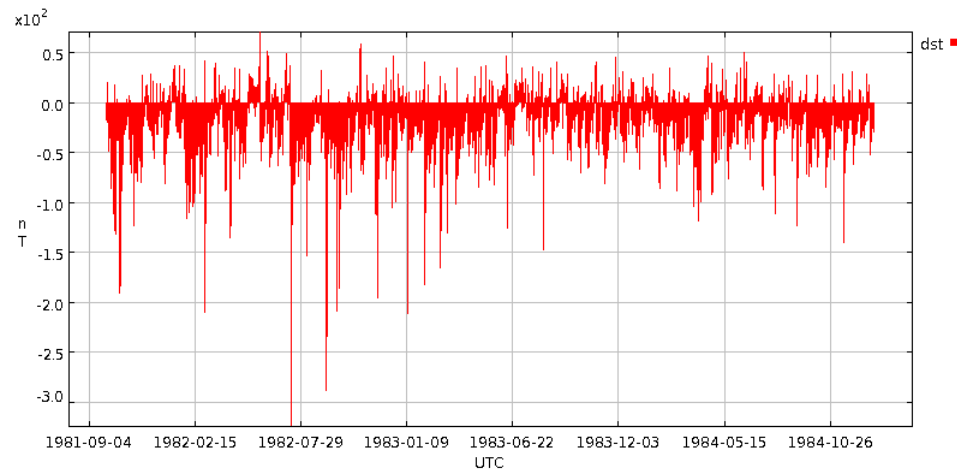
F10.7



Kp

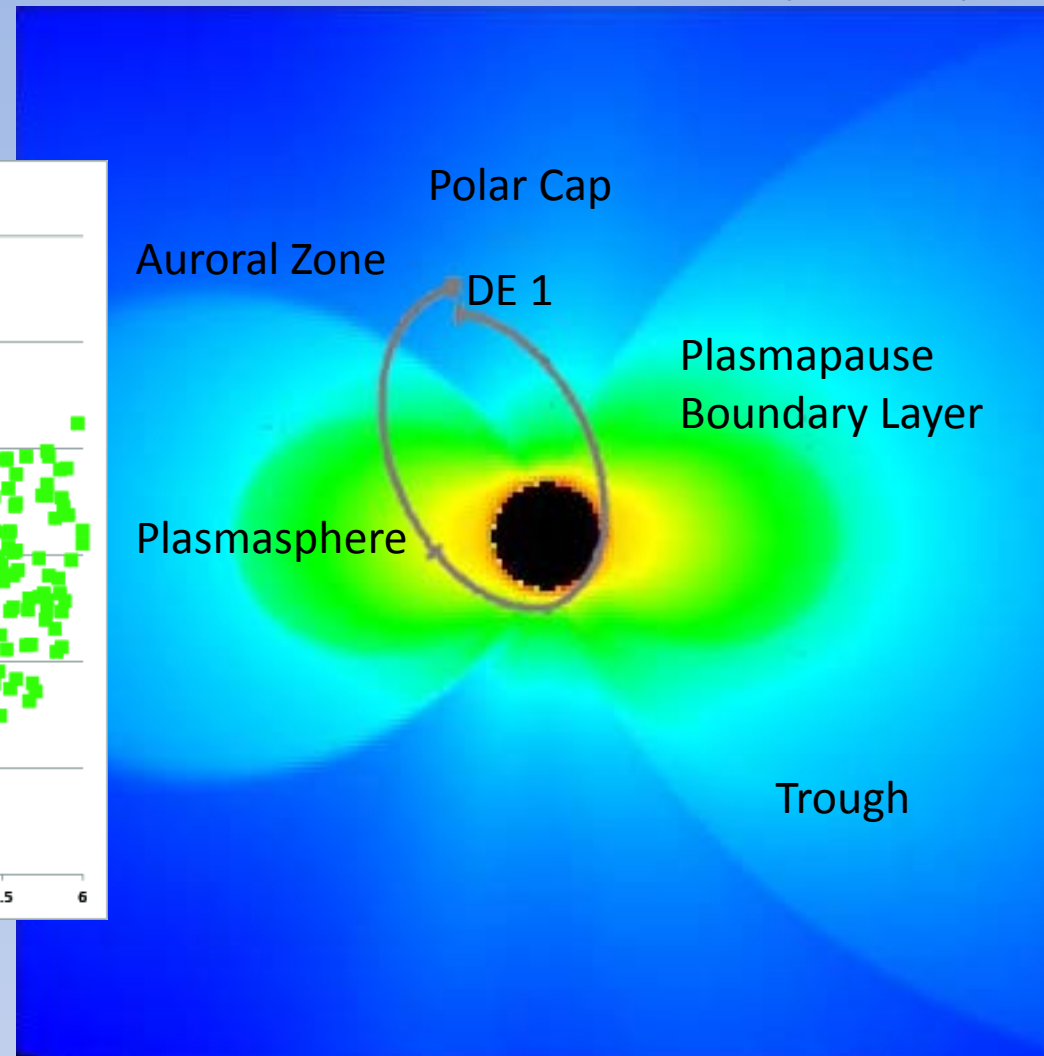
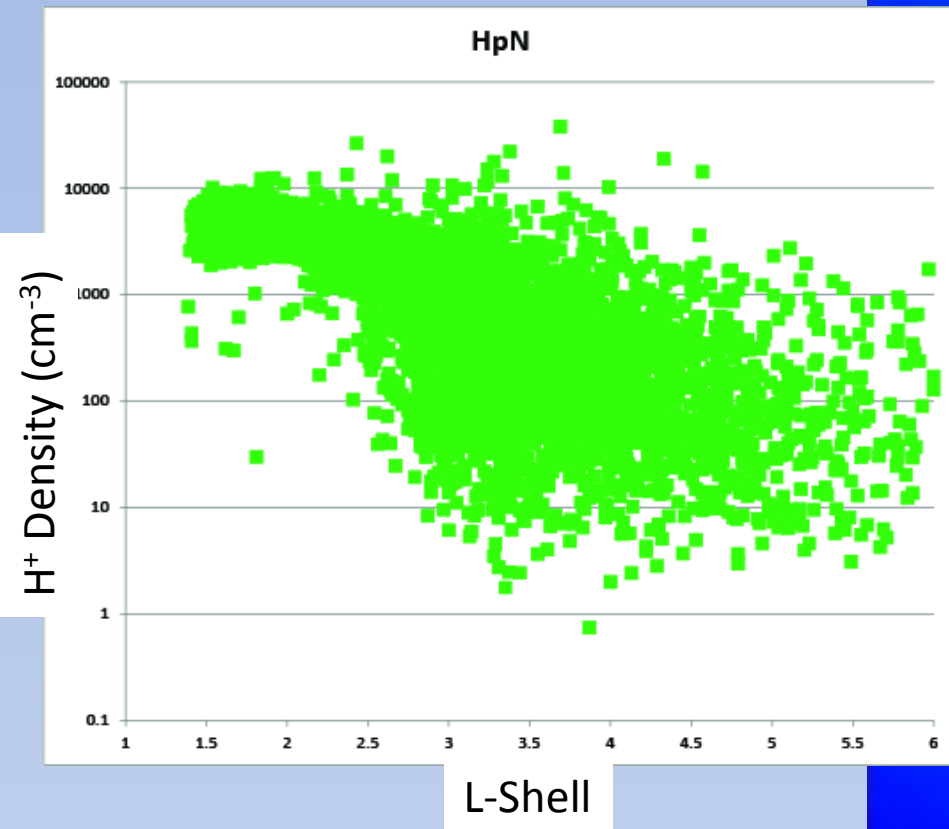


Dst



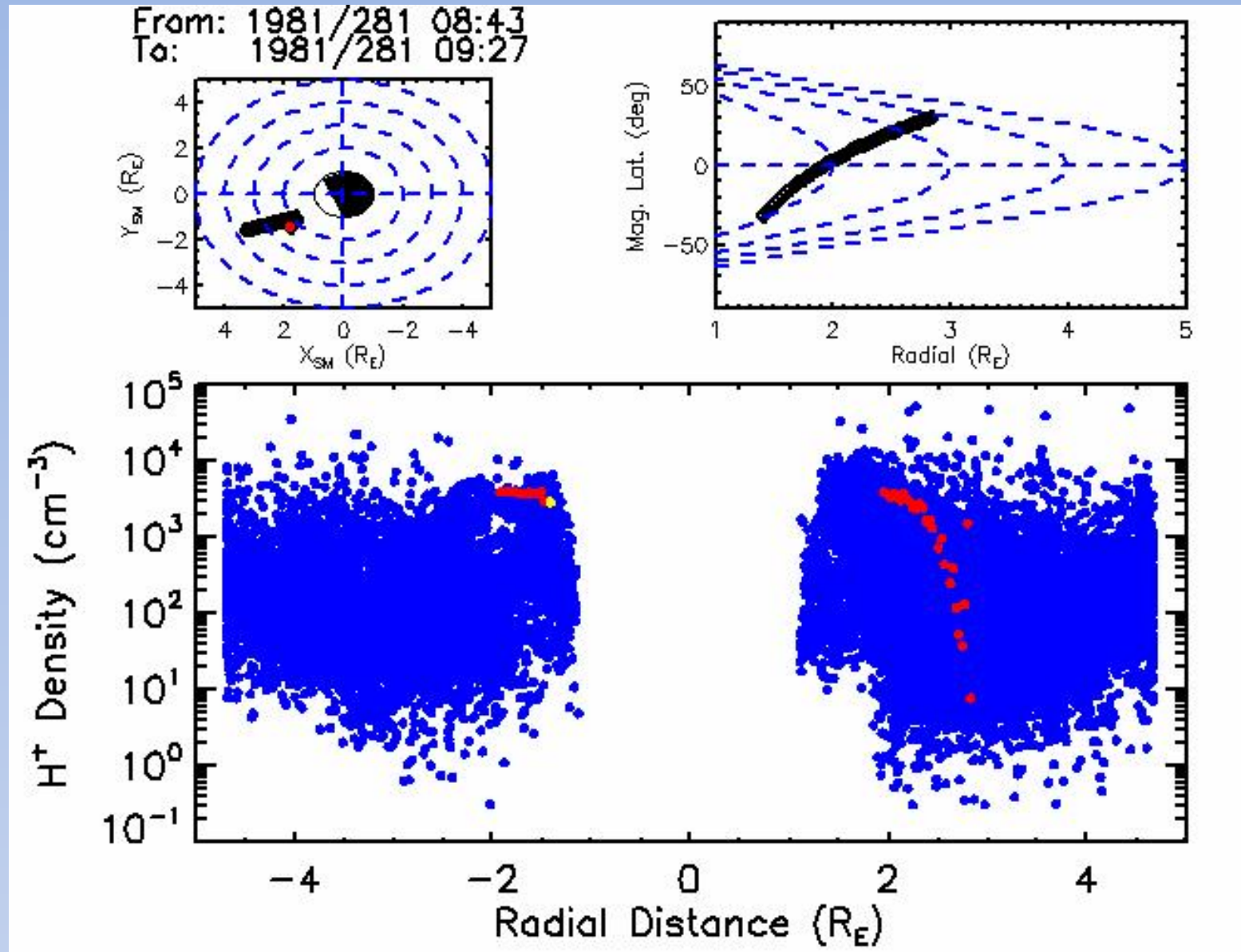
The In Situ Challenge for DE 1 RIMS

Global Core Plasma Model (GCPM)

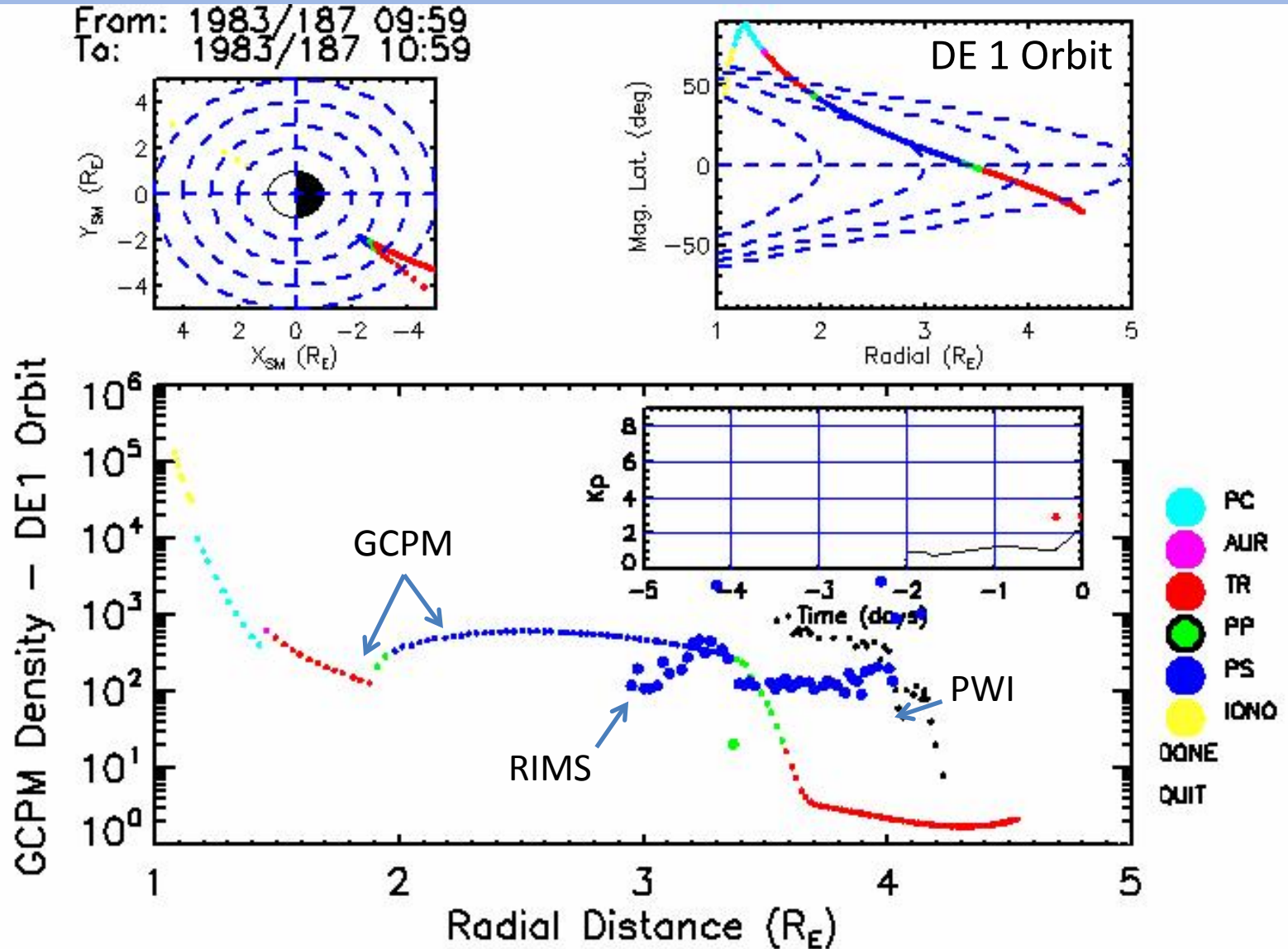


Gallagher et al., 2000

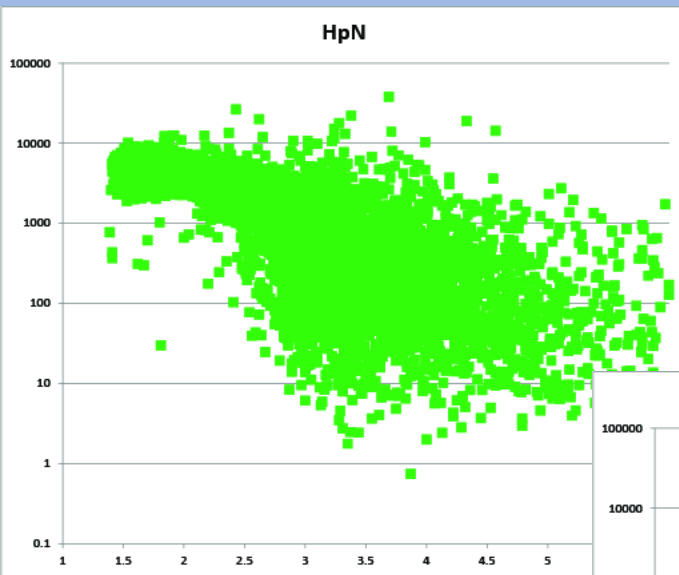
Morphological Regions are Mixed



Separating Morphological Regions



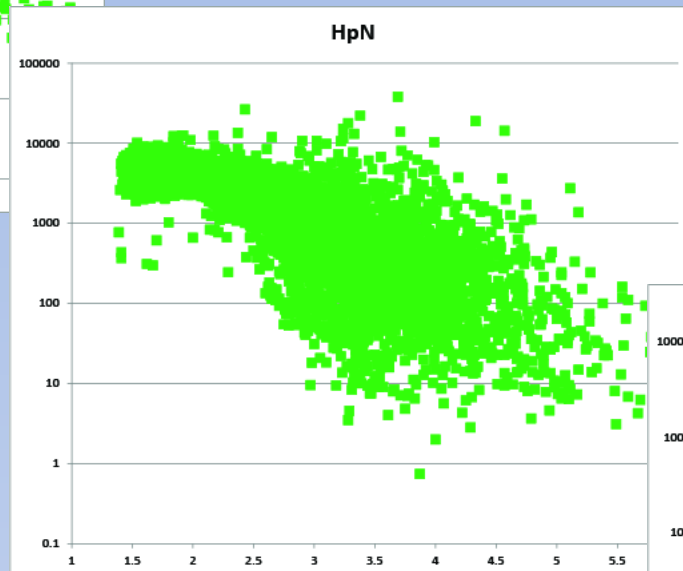
Plasmaspheric H^+ Densities Versus L



L-Shell

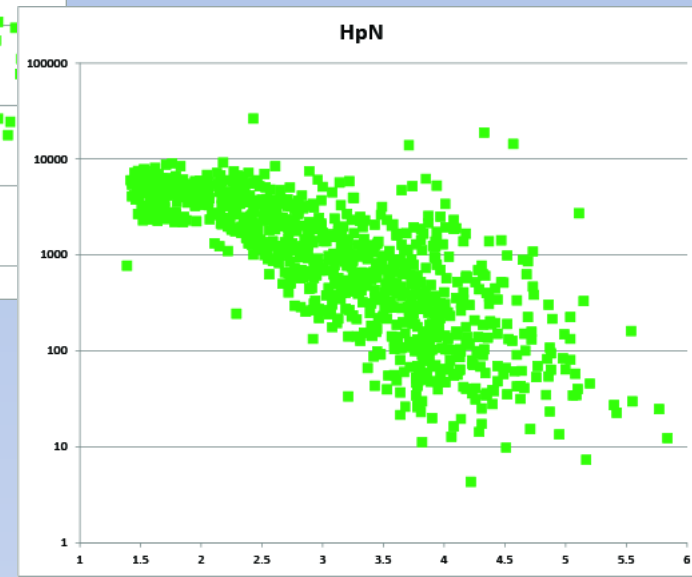
All H^+ Density Values;
all conditions

It is important to ask
the right questions too.

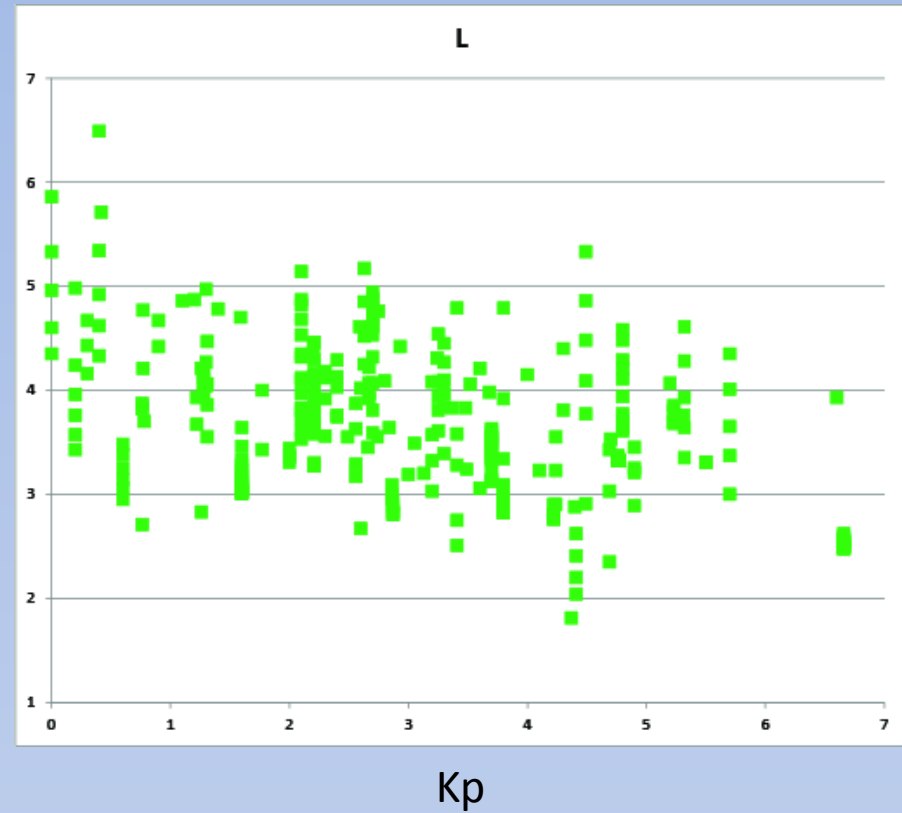
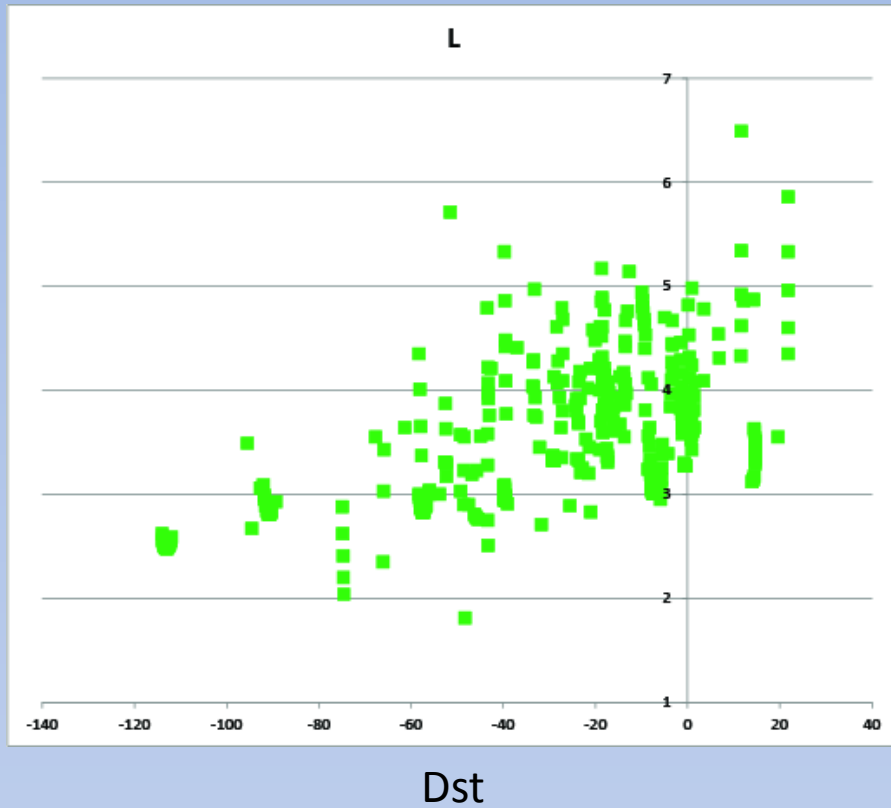


Plasmasphere H^+
Density Values for
 $K_p \leq 2$ and 3-day
steady conditions

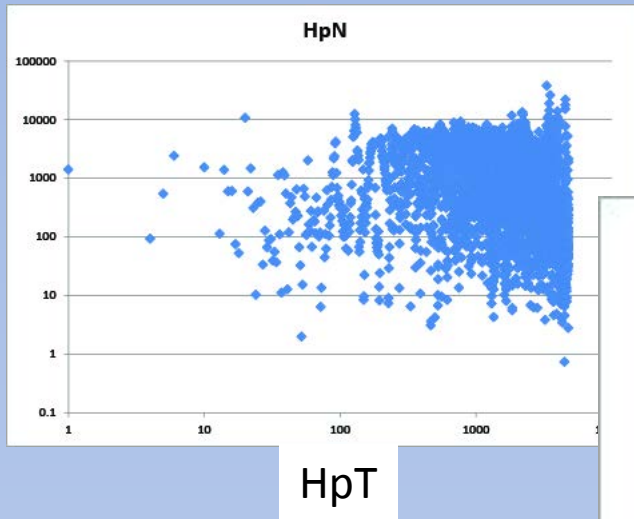
Plasmasphere H^+
Density values only;
all conditions



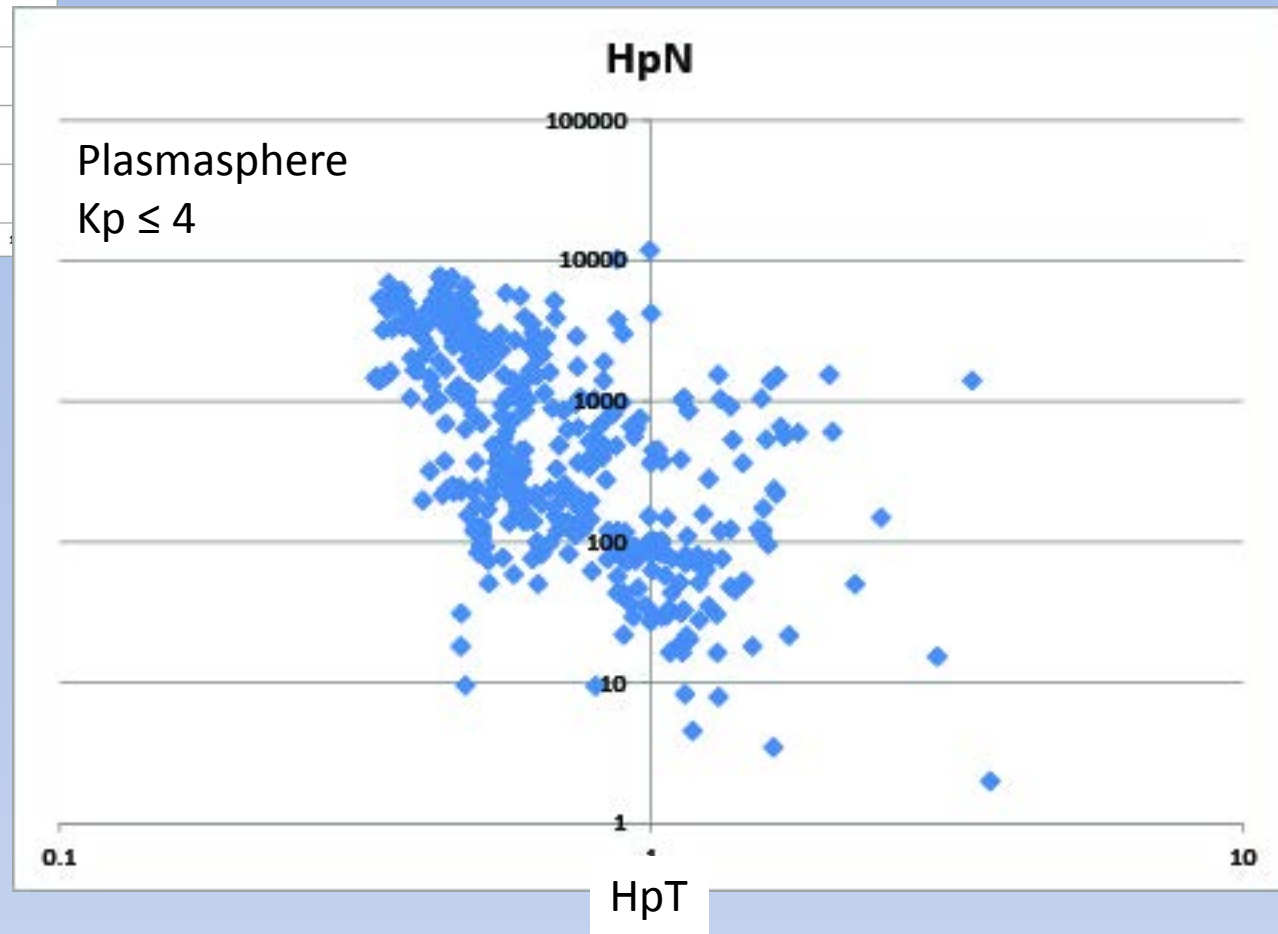
L-shell Plasmopause Locations



Plasmasphere H^+ Density Versus H^+ Temperature

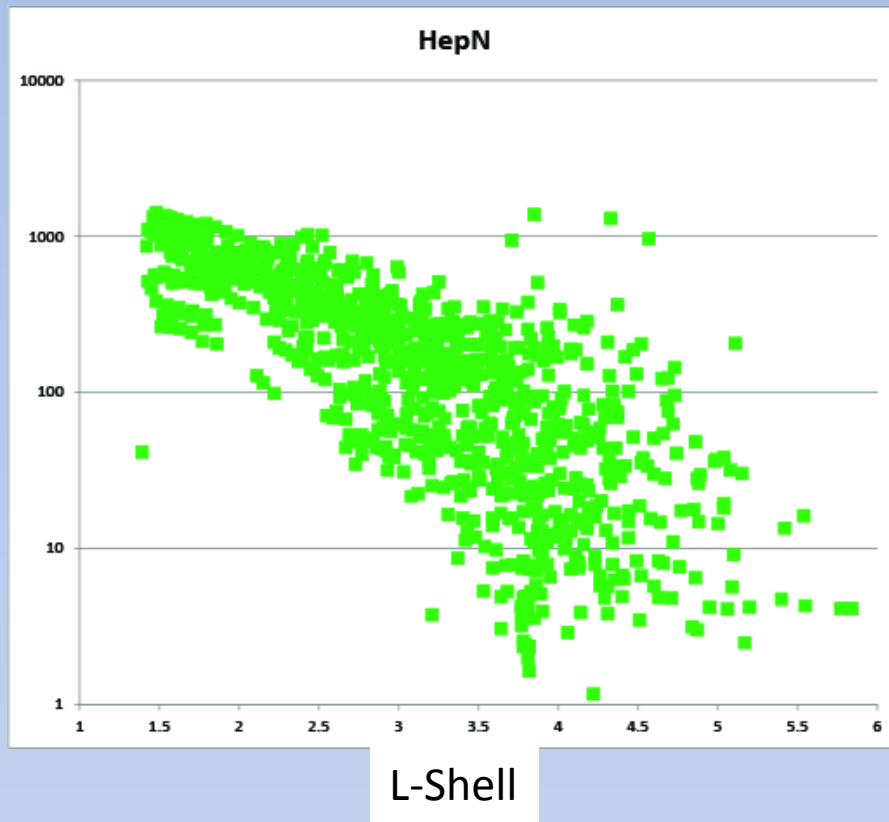


Plasmasphere – all values

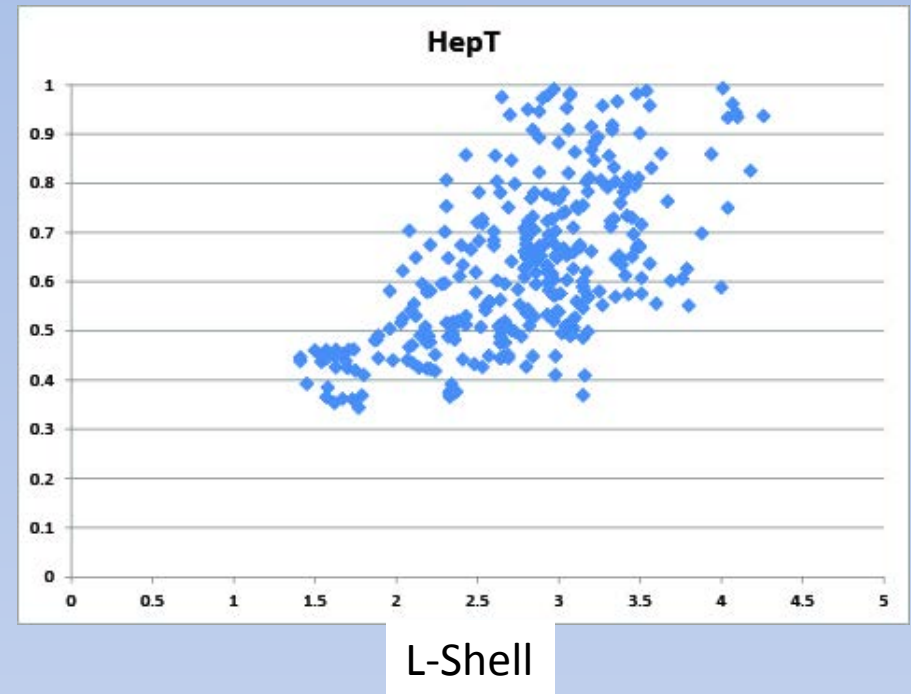


Plasmasphere He+ Density & Temperature Versus L-Shell

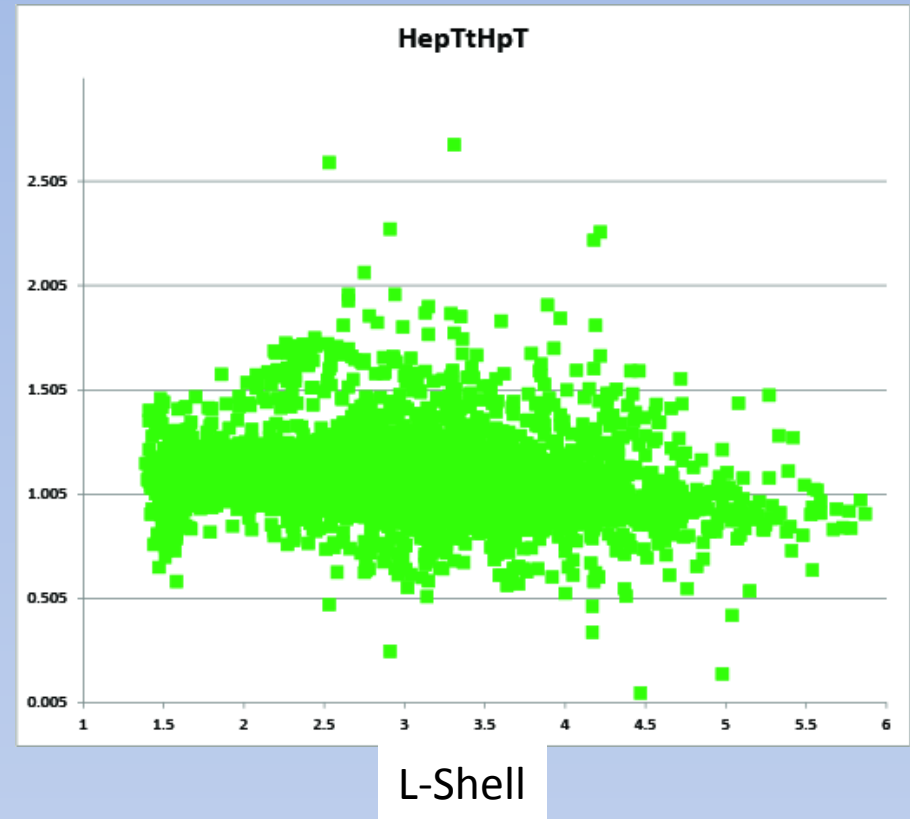
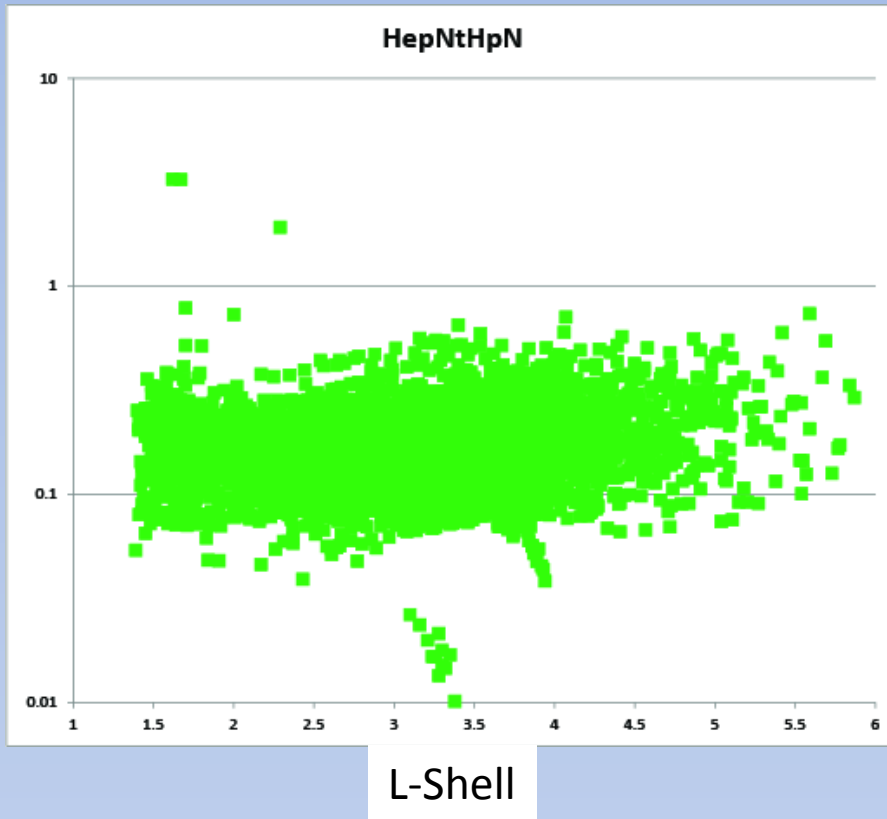
$K_p \leq 2$ and 3-day
steady conditions



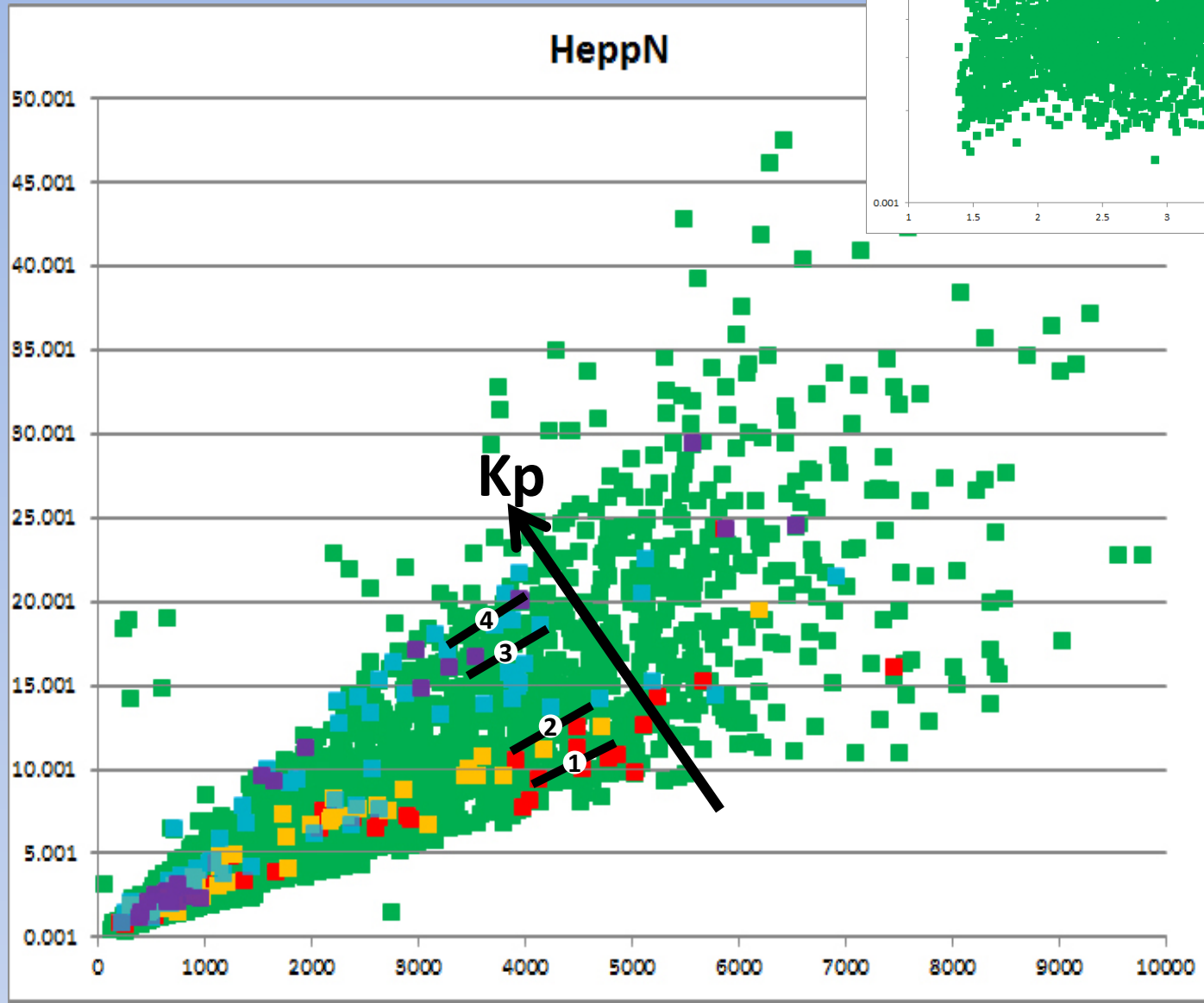
$K_p \leq 4$



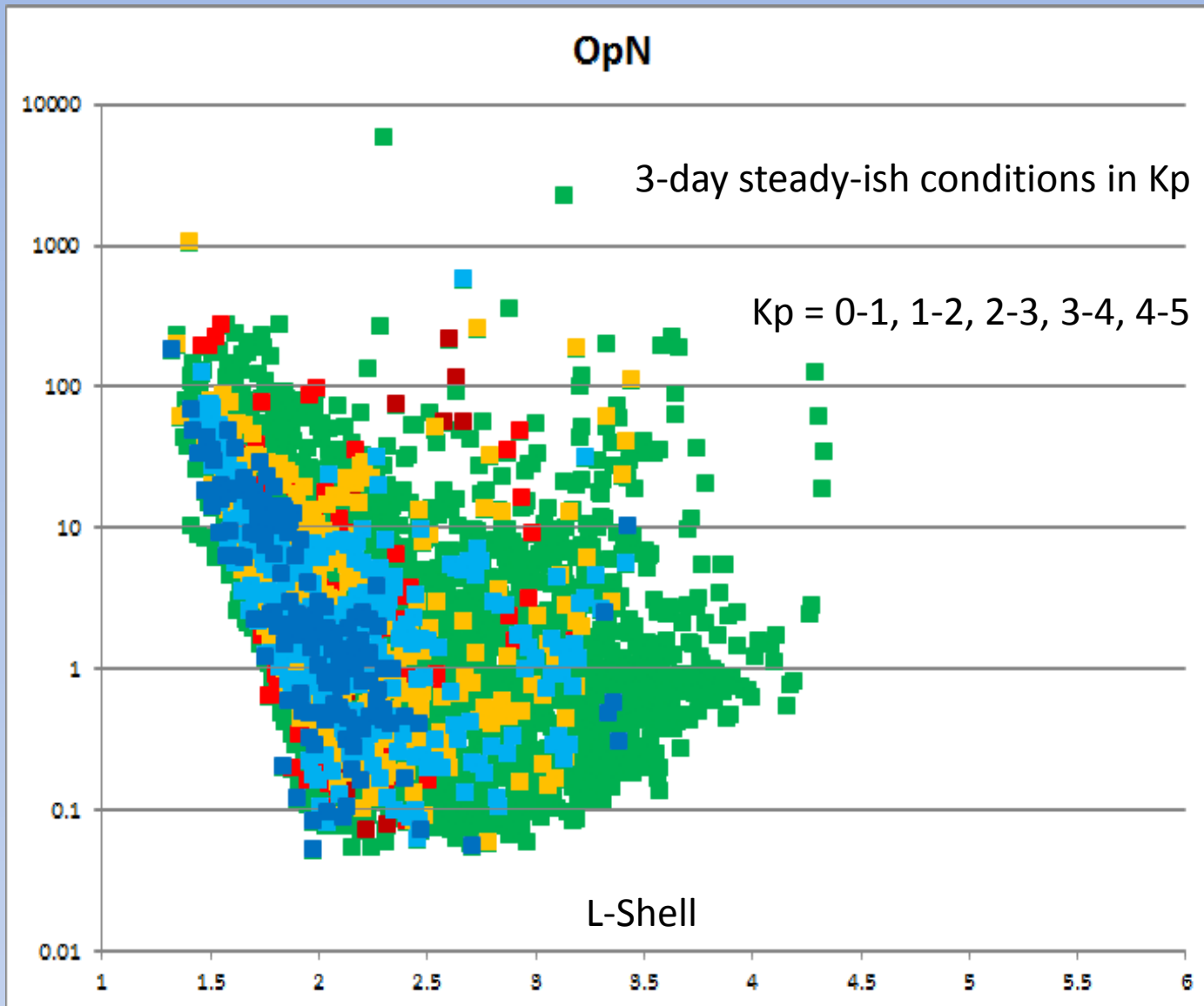
He⁺/H⁺ Density & Temperature in the Plasmasphere Versus L-Shell



He⁺⁺ Versus H⁺ Densities With Kp Dependence



O⁺ Density Versus L-Shell in the Plasmasphere



Work Space

Plasmasphere	H ⁺	He ⁺	He ⁺⁺	O ⁺	O ⁺⁺
Density	vs L	vs L	vs N _{H⁺}	vs L	?
Temperature	vs N _{H⁺}	vs L	?	?	?
Conditions	Steady-quiet	?	Kp	?	?

Plasmapause	Dependencies
Location	vs Kp & Dst, MLT?
Gradient	?

What's Next?

- Initial analysis required H^+ , He^+ , and O^+ densities/temperatures to be available, which limited data to about 3,400 values.
- If analysis is expanded to only require H^+ and He^+ to be available, the data grows to over 34,000 values.
- But will this same analysis be possible and will the results hold up? More than half of the work space must be filled in.
- Interestingly Huba et al., GRL [2000] find an electron hole above the equatorial ionospheric F2 peak, but had no observations to confirm. RIMS appears to see this hole in the initial analysis! Will it survive expansion of the dataset?
- Everyone needs and no one has the composition densities and temperatures in the plasmasphere that RIMS offers, so the push is on to get this out.